

**A CHECKLIST OF COMMONLY INTERCEPTED THRIPS (THYSANOPTERA)
FROM EUROPE, THE MEDITERRANEAN, AND AFRICA AT
U.S. PORTS-OF-ENTRY (1983-1999), PART 1. KEY TO GENERA**

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Abstract.—Although there are more than 1,000 described species of thrips from Europe, the Mediterranean region, and Africa, since 1983 only 130 species have been intercepted in cargo and shipments of plants coming into the various ports-of-entry in the United States. Of these, only 23 species consistently made up ca. 85% of the identifiable thrips. This paper is a checklist of thrips commonly intercepted on plants coming into the U.S. from Europe, the Mediterranean region, and Africa; keys with figures are included for the 57 represented genera. It is the first of a five-part series aimed to facilitate identifications by port identifiers at U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA, APHIS), ports-of-entry.

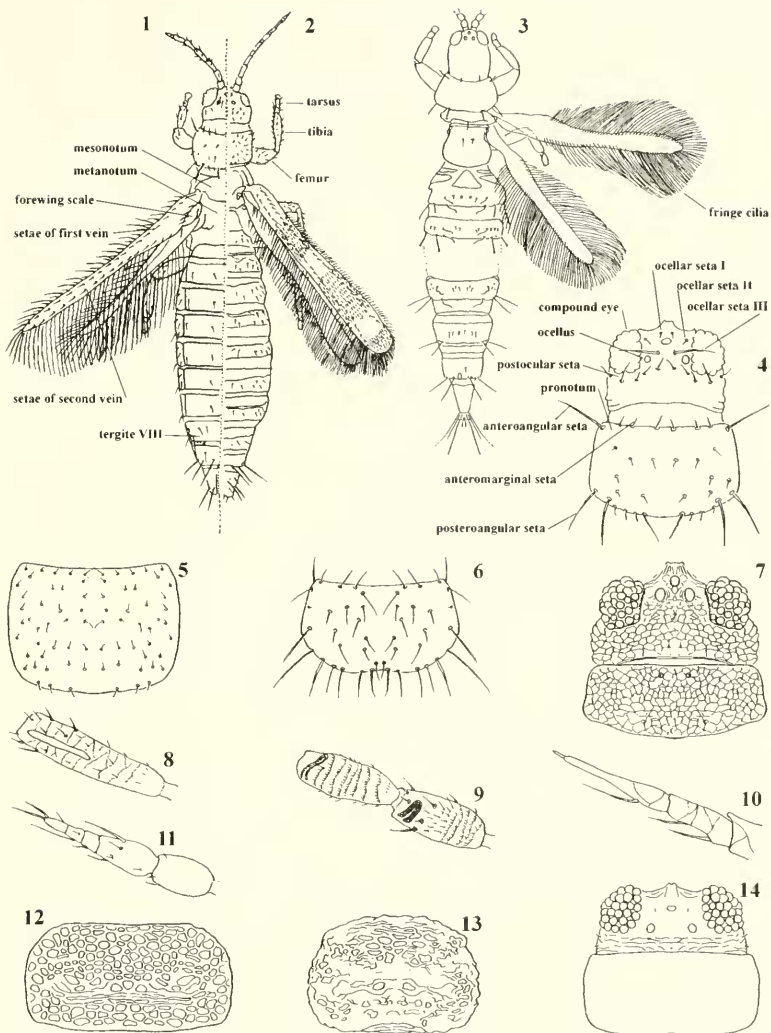
Key Words: thrips, pests of flowers, Europe, Africa

Thrips (Thysanoptera) are a group of minute insects usually less than 1.0 mm in length. Most species are fully alate as adults, with 2 pairs of narrow membranous wings having few or no veins but with well developed fringe-like cilia around the margins. The sexes of thrips are similar in most anatomical structures, but parthenogenesis is common among some species, and males are often rare in other species (Stannard 1968).

Metamorphosis is complex, usually with

active larval stages (I and II), a propupa and pupa in Terebrantia and propupa, pupa I and pupa II in Tubulifera, followed by the adult stage (upon which this paper is based). Many species feed on plant tissue of many host plants, including agriculturally important fruits and vegetables, and cutflowers imported into this country from abroad. Some species are host specific or feed on a limited variety of closely related plant species; others are polyphagous; some species are predaceous, feeding on mites

Figs. 1-14. Morphological features of Thysanoptera. 1, Thripidae (*Thrips* sp.), dorsal aspect, showing left half with selected structures. 2, Aeolothripidae (*Stomatothrips* sp.), dorsal aspect, right half. 3, Phlaeothripidae (*Haplothrips* sp.), dorsal aspect, showing right wings only. 4, Head and pronotum of a thrips (*Frankliniella* species), dorsal aspect, showing ocellar setae I, II, and III. 5, *Aeolothrips* pronotum, dorsal aspect. 6, *Melanthrips* pronotum, dorsal aspect. 7, *Retithrips syriacus*, head and pronotum, dorsal aspect. 8, *Aeolothrips* sp., antennal segment III. 9, *Melanthrips* sp., antennal segment III. 10, *Retithrips syriacus*, terminal antennal segments. 11, *Dendrothrips ornatus*, terminal antennal segments. 12, *Heliethrips haemorrhoidalis*, pronotum showing regular sculpturation, dorsal aspect. 13, *Rhipiphorothrips miemsaе*, pronotum showing irregular sculpturation, dorsal aspect. 14, *Dendrothrips ornatus*, head and pronotum, dorsal aspect.



and small insects or on other thrips (Mound et al. 1976).

Although literature is extensive regarding the biology, systematics, behavior, and pest potential of thrips [e.g., see Kirk (1996), Lewis (1997), and Parker et al. (1991) for reviews with presentations of the literature], there is a need for regional guides to identify species inadvertently transported in international commerce of agricultural and horticultural shipments. This paper is the first of a series of identification guides for the more commonly intercepted thrips from a particular region arriving in ports of the United States and is meant to facilitate identification of those species most frequently found in flowers, fruits, and leaves of a wide range of commodities. It is modeled in part after a similar recently published paper on the identification of larval Pyraloidea (Lepidoptera) intercepted in U.S. ports-of-entry (Solis 1999). It condenses identification keys already in existence on either a worldwide scope (Mound and Kibby 1998) or a more limited regional scope (e.g., parts of Europe only or Africa only) (Dyadechko 1977, Mound et al. 1976, Priesner 1964) to include only the thrips most likely to be encountered in commerce from Europe/Mediterranean Region/Africa. It also makes use of information derived from generic revisions—e.g., *Odontothrips* (Pitkin 1972), *Thrips* (Nakahara 1994), *Frankliniella* (Moulton 1948), *Anaphothrips*, *Ceratothrips*, and *Tenothrips* (Bhatti 1967, 1973, 1978, 1990)—or of information derived from species lists (e.g., Nakahara 1997, 1999) and catalogs (Jacot-Guilarmod 1970–1977). Obviously, many genera and species have been excluded from this treatment, but conversely, it is unlikely that those species would be received in produce and other commerce that routinely enters the United States. This paper is based on the adult female sex only, partly because males are seldom encountered in the small sampling procedures used by port inspectors and partly because for many species—even some economically important ones—

males have not been described or adequately treated. Because life stages of many species have not been fully studied, immature stages also are excluded from this paper, although keys to immature stages are available for selected species, some of which are included herein (Nakahara and Vierbergen 1998).

This paper (Part 1) is the first of a 5-part series directed at identifying thrips from Europe/Mediterranean region/Africa commonly intercepted by USDA/APHIS port identifiers. It is intended to provide an overview of the diversity of thrips entering this country and to indicate the frequency that each species was encountered over a 17-year period from 1983–2000. Clearly, some species commonly are encountered, while others are rare. In order to sort out this diversity, a key to 57 represented genera is included, along with figures (both line drawings and scanning electron micrographs) to facilitate identifications to genus level.

Parts 2 and 3 will treat those species comprising a significant proportion of the intercepted fauna, i.e., thripine species sharing the character of the presence of ctenidia on tergite VIII: part 2 will cover *Frankliniella* and related genera (16 species) and part 3, the genus *Thrips* (23 spp.). Part 4 will treat the 52 remaining species of Thripidae (6 spp. in 5 genera of Panchaethripinae and 46 spp. in 33 genera of Thripinae). Part 5 will deal with Aeolothripidae (15 spp. in 3 genera) and Phlaeothripidae (21 spp. in 5 genera).

Sources of quarantine interceptions include commercial shipments, inspections of passenger baggage, aircraft or ship quarters, stores, galleys, and mail. In fact, most interceptions are from aircraft quarters. Notwithstanding, nearly 1,000 samples are annually sent the Systematic Entomology Laboratory, USDA, for urgent identification of unknown thrips samples representing species that cannot be reliably identified at ports-of-entry and which require immediate identification for action at the ports.

Table 1. Species of thrips intercepted at ports of entry (Numbers represent accumulated interceptions over the period 1983–1999). Ranges of species in Europe, the Mediterranean, and Africa are indicated with an "x." Establishment or occurrence of any of these species in the United States also is indicated by an "x" under U.S.

		Eur	Med	Afr	U.S
AEOLOTHRIPIDAE					
<i>Aeolothrips</i> Haliday 1836					
<i>brevicornis</i> Bagnall 1915	2			x	
<i>bucheti</i> Bagnall 1934	4			x	
<i>collaris</i> Priesner 1919	5	x	x	x	x
<i>deserticola</i> Priesner 1929	4		x	x	
<i>ericae</i> Bagnall 1920	3	x	x		
<i>fasciatus</i> (Linnaeus 1758)	1	x	x	x	x
<i>intermedius</i> Bagnall 1934	13	x			
<i>linarius</i> Priesner 1948	1		x		
<i>meridionalis</i> Priesner 1948	1	x	x	x	
<i>scabiosatibia</i> Moulton 1930	7			x	
<i>tenicornis</i> Bagnall 1926	1	x			
undetermined species	31				
<i>Franklinothrips</i> Back 1912					
<i>vespiformis</i> (Crawford 1909)	1	[x]			x
<i>Melanthrips</i> Haliday 1836					
<i>fuscus</i> (Sutzer 1776)	11	x	x	x	
<i>gracilicornis</i> Maltbaek 1931	4	x	x	x	
<i>pallidior</i> Priesner 1919	2	x	x	x	
undetermined species	6				
THRIPIDAE					
<i>Anaphothrips</i> Uzel 1895					
<i>articulosus</i> Priesner 1925	1	?			
<i>obscurus</i> (Müller) 1776	14	x		x	x
<i>sudanensis</i> Trybom 1911	1		x	x	
<i>Apterothrips</i> Bagnall 1908					
<i>apteris</i> Daniel 1904	1				x
<i>secticornis</i> (Trybom 1896)	1	x			x
<i>Aptinothrips</i> Haliday 1836					
<i>rufus</i> (Goeze 1776)	1	x	x	x	x
<i>stylifer</i> Trybom 1894	1	x			x
<i>Ceratothripoides</i> Bagnall 1918					
<i>brunneus</i> Bagnall 1918	7			x	
<i>Ceratothrips</i> Hood 1919					
<i>ericae</i> (Haliday 1836)	7	x			
<i>Chaetanaphothrips</i> Priesner 1957					
undetermined species	4				
<i>Chirothrips</i> Haliday 1836					
<i>aculeatus</i> Bagnall 1927	2	x			x
<i>manicatus</i> (Haliday 1836)	6	x	?		x
<i>meridionalis</i> Bagnall 1927	1	x	x	x	
<i>mexicanus</i> Crawford 1909	1			x	x
<i>Dendrothripoides</i> Bagnall 1923					
<i>innoxius</i> Karny 1914	1			x	x
<i>venustus</i> Faure 1941	1			x	
undetermined species	1				

Table 1. Continued.

		Eur.	Med.	Afr.	U.S.
<i>Dendrothrips</i> Uzel 1895					
<i>degeeri</i> Uzel 1895	2	x			
<i>ornatus</i> (Jablonowski 1894)	5	x			x
<i>saltator</i> Uzel 1895	2	x			
undetermined species	1				
<i>Dichromothrips</i> Priesner 1932					
<i>corbetti</i> (Priesner 1936)	1	[?]			x
undetermined species	1				
<i>Drepanothrips</i> Uzel 1895					
<i>reuteri</i> Uzel 1895	4	x			x
<i>Echinothrips</i> Moulton 1911					
<i>americanus</i> Morgan 1913	1	x			x
<i>Frankliniella</i> Karny 1910					
<i>fusca</i> (Hinds 1902)	7	x			x
<i>intonsa</i> (Trybom 1895)	94	x	x		
<i>occidentalis</i> (Pergande 1895)	448	x	x	x	x
<i>pallida</i> (Uzel 1895)	1	x			
<i>schultzei</i> (Trybom 1910)	55	x	x	x	
<i>tenicornis</i> (Uzel 1895)	136	x	x		x
<i>tritici</i> (Fitch 1855)	3				x
undetermined species	72				
<i>Glaucothrips</i> Karny 1921					
<i>glaucus</i> (Bagnall 1914)	5			x	
<i>Heliothrips</i> Haliday 1836					
<i>haemorrhoidalis</i> (Bouché 1838)	5	x	x	x	x
<i>Hercinothrips</i> Bagnall 1932					
<i>bicinctus</i> (Bagnall 1919)	1			x	
<i>dinidiatus</i> Hood 1937	1			x	
<i>Iridothrips</i> Priesner 1940					
<i>iridis</i> (Watson 1924)	2	x			x
<i>Leucothrips</i> Reuter 1904					
undetermined species	1				
<i>Limothrips</i> Haliday 1836					
<i>cerealium</i> (Haliday 1836)	18	x	x	x	x
<i>denticornis</i> (Haliday 1836)	9	x			x
undetermined species	1				
<i>Megalurothrips</i> Bagnall 1915					
<i>sjöstedti</i> (Trybom 1910)	5			x	
undetermined species	1				
<i>Microcephalothrips</i> Bagnall 1926					
<i>abdominalis</i> (Crawford 1910)	5			x	x
<i>Mycterothrips</i> Trybom 1910					
<i>consociatus</i> (Targioni-Tozzetti 1887)	2	x			
<i>latus</i> (Bagnall 1912)	7	x			
undetermined species	1				
<i>Neohydatothrips</i> John 1929					
<i>samayunkur</i> (Kudo 1995)	13		x	x	
undetermined species	2				

Table 1. Continued.

		Eur.	Med	Atr	U.S.
<i>Odontothrips</i> Amyot & Serville 1843					
<i>karnyi</i> Priesner 1924	132	x	x	x	
undetermined species	2				
<i>Oxythrips</i> Uzel 1895					
<i>nobilis</i> Bagnall 1927	1	x			
undetermined species	1				
<i>Palmiothrips</i> zur Strassen 1965					
<i>amulicornis</i> zur Strassen 1965	1	x			
<i>Parthenothrips</i> Uzel 1895					
<i>dracaenae</i> (Heeger 1854)	3	x		x	x
<i>Prosopothrips</i> Uzel 1895					
<i>nigriceps</i> Bagnall 1927	1	x	x		
<i>Retithrips</i> Marchal 1910					
<i>syriacus</i> (Mayet 1890)	2		x	x	x
<i>Rhipiphorothrips</i> Morgan 1913					
<i>miemsae</i> Jacot-Guillarmod 1937	2			x	
<i>Scirtothrips</i> Shull 1909					
<i>aurantii</i> Faure 1929	5			x	
<i>dorsalis</i> Hood 1919	3			x	
<i>inermis</i> Priesner 1933	1	x			x
undetermined species	3				
<i>Scolothrips</i> Hinds 1902					
<i>longicornis</i> Priesner 1926	1	x			
<i>Selenothrips</i> Karny 1911					
<i>rubrocinctus</i> (Giard 1901)	1			x	x
<i>Synaptothrips</i> Trybom 1910					
<i>africanus</i> (Moulton 1936)	1			x	
<i>distinctus</i> (Bagnall 1915)	9			x	
<i>gezinae</i> (Faure 1938)	6			x	
undetermined species	7				
<i>Taeniothrips</i> Amyot & Serville 1845					
<i>inconsequens</i> (Uzel 1895)	3	x			x
<i>Tameothrips</i> Bhatti 1978					
<i>tanicola</i> (Bagnall 1914)	1	x			
<i>Tenothrips</i> Bhatti 1967					
<i>discolor</i> (Karny 1907)	9	?	x		
<i>frici</i> (Uzel 1895)	4		x		
undetermined species	5	x			
<i>Thrips</i> Linnaeus 1758					
<i>acaciae</i> Trybom 1910	2			x	
<i>angusticeps</i> Uzel 1895	24	x	x	x	
<i>italicus</i> (Karny 1907)	24	[x]			
<i>atratus</i> (Haliday 1836)	52	x	x		x
<i>australis</i> (Bagnall 1915)	10	x	x	x	x
<i>brevicornis</i> Priesner 1920	3	x			
<i>flavus</i> Shrank 1776	28	x			
<i>fulvipes</i> Bagnall 1923	6	x			
<i>fuscipennis</i> Haliday 1836	200	x			x

Table 1. Continued.

		Eur.	Med	Afr.	U.S.
<i>trehernei</i> Priesner 1937	1	?			
<i>italicus</i> (Bagnall 1926)	30	x			
<i>major</i> Uzel 1895	178	x	x	x	
<i>marcoticus</i> (Priesner 1932)	1	x			
<i>meridionalis</i> (Priesner 1926)	23	x	x	x	
<i>microchaetus</i> Karny 1920	1			x	
<i>minutissimus</i> Linnaeus 1758	7	x	x		
<i>nigropilosus</i> Uzel 1895	9	x	?	x	x
<i>palmi</i> Karny 1925	11			x	x
<i>physapus</i> Linnaeus 1758	1	x			
<i>pilichi</i> Priesner 1924	1	x			
<i>simplex</i> (Morison 1930)	26	x	x	x	x
<i>spadix</i> Hood 1932	1			x	
<i>tabaci</i> Lindeman 1889	474	x	x	x	x
<i>tenellus</i> Trybom 1912	1			x	
<i>urticae</i> Fabricius 1781	3	x			
<i>vulgatissimus</i> (Haliday 1836)	98	x			x
undetermined species	37				
PHLAEOTHIRIPIDAE					
<i>Aleurothrips</i> Franklin 1909					
<i>fasciapennis</i> (Franklin 1908)	1	x			x
<i>Bolothrips</i> Priesner 1926					
<i>cugulatus</i> (Karny 1916)	1			x	
<i>Elaphrothrips</i> Buffa 1909					
undetermined species	2				
<i>Eparsothrips</i> zur Strassen 1968					
<i>varicornis</i> (Bagnall 1919)	4			x	
<i>Gynaikothrips</i> Zimmermann 1900					
<i>ficorum</i> (Marchal 1908)	1			x	x
<i>Haplothrips</i> Amyot & Serville 1843					
<i>aculeatus</i> Fabricius 1803	4	x		x	
<i>articulosus</i> Bagnall 1926	3			x	
<i>cerealis</i> Priesner 1939	1		x		
<i>clarisetis</i> Priesner 1930	2			x	
<i>distinguendus</i> Uzel 1895	2	x	x		
<i>fuliginosus</i> Schille 1912	1	x			
<i>gowdeyi</i> (Franklin 1908)	65	x	x	x	x
<i>nigricornis</i> Bagnall 1910	12			x	
<i>reuteri</i> (Karny 1907)	4	x			
<i>settiger</i> Priesner 1921	1	x			
<i>subtillissimus</i> (Haliday 1836)	2	x			
undetermined species	23				
<i>Hoplandrothrips</i> Hood 1912					
<i>ellisi</i> Bagnall 1914	1	x			
<i>flavipes</i> Bagnall 1923	2			x	x
undetermined species	1				
<i>Karnyothrips</i> Watson 1924					
<i>flavipes</i> (Jones 1912)	2	x	x		x
<i>melaleucus</i> (Bagnall 1911)	1	?			x
undetermined species	2				

Table 2. Complete list of species of thrips intercepted from commerce from Europe and Africa at U.S. ports of entry, 1994–1999 (species in bold font represent most frequently intercepted species, tabulated in Table 3).

Phlaeothripidae

- Haplothrips articulosus* Bagnall 1895?
Haplothrips fuliginosus Schille 1912
***Haplothrips gowdeyi* (Franklin 1908)**
Haplothrips nigricornis Priesner 1910
Hoplathothrips sp.

Acolothripidae

- Acolothrips brevicornis* Bagnall 1915
***Acolothrips collaris* Priesner 1919**
***Acolothrips deserticola* Priesner 1929**
Acolothrips intermedialis Bagnall 1934
Acolothrips tenuicornis Bagnall 1926
Franklinothrips sp.
***Melanthrips fuscus* (Sulze 1776)**

Thripidae

- Anaphothrips obscurus* Müller 1776
Anaphothrips sudanensis Trybom 1911
Chirothrips manicatus (Haliday 1836)
Chirothrips meridionalis Bagnall 1927
***Dendrothrips ornatus* (Jahlonowski 1894)**
***Frankliniella intonsa* (Trybom 1895)**
***Frankliniella occidentalis* (Pergande 1895)**
***Frankliniella schultzei* (Trybom 1910)**
***Frankliniella tenuicornis* (Uzel 1895)**
***Limothrips ceralium* (Haliday 1836)**
***Limothrips denticeornis* (Haliday 1836)**
***Neohydatothrips samayunkur* (Kudo 1995)**
Odontothrips karnyi Priesner 1924
Oxythrips sp.
Parthenothrips dracaenae (Heeger 1854)
Taeniothrips inconspuens (Uzel 1895)
Tenothrips discolor (Karny 1907)
***Thrips atratus* (Haliday 1836)**
***Thrips australis* (Bagnall 1915)**
Thrips brevicornis Priesner 1920
***Thrips flavus* (Schrank 1776)**
***Thrips fuscipennis* Haliday 1836**
Thrips italicus (Bagnall 1926)
***Thrips major* Uzel 1895**
***Thrips meridionalis* (Priesner 1926)**
***Thrips nigropilosus* Uzel 1895**
Thrips physapus Linnaeus 1758
***Thrips simplex* (Morison 1930)**
***Thrips tabaci* Lindeman 1889**
Thrips trehernei Priesner 1927
***Thrips vulgatissimus* (Haliday 1836)**
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It is an economically expensive proposition to protect U.S. agriculture and horticulture. This protection requires time invested in identifying specimens at each port, sending suspect specimens to taxonomic specialists connected with the Systematic Entomology Laboratory for final identifications, and actions taken once identifications are made to resolve issues involving the entry status of infested shipments. When completed, these papers should provide identifiers and others with a powerful resource for identifying potential European, Mediterranean, and African thrips pests regularly threatening U.S. agriculture and horticulture.

MATERIALS AND METHODS

Two databases of thrips identifications, available to me at the Systematic Entomology Laboratory, were used to determine the species that were intercepted in shipments from European, Near East, and African countries. The first included species intercepted between 1983 and 1993 (Table 1), and the second for species intercepted from 1994 to 1999 (Table 2). Both databases included information concerning the country of origin, the plant host on which the specimen was found, and the identification of the thrips taxon. Records of interceptions originating from The Netherlands are often deceiving, since The Netherlands is host to the international market wherein cut flowers from all parts of the world are auctioned. The Netherlands Plant Protection Service has a staff at the flower market and auction in Alrmeer. Although cut flowers are inspected entering The Netherlands and other EU countries, consignments transshipped to the U.S. and other countries are usually not inspected, and many thrips are transported with their hosts in cargos. The first database (containing a total of 2,437 interceptions) (Table 1) and the second database (of 497 specimens) (Table 2) provided the basis for this study.

These databases do not include thrips that were intercepted and identified by

Table 3. Most frequently intercepted thrips from Europe and Africa at U.S. ports of entry, 1994–1999, based on a database of 497 identified specimens. Species were ranked from most frequently intercepted to species represented by more than unique specimens.

Species	Rank	Number of Interceptions	% of Total (n = 497)	Cumulative Percent
<i>Thrips tabaci</i>	1	81	20.0	20.0
<i>Frankliniella occidentalis</i>	2	59	14.6	34.6
<i>Thrips fuscipennis</i>	3	41	10.1	44.7
<i>Thrips major</i>	4	32	7.9	52.6
<i>Thrips vulgaticornis</i>	5	22	5.4	58.0
<i>Odontothrips kariyai</i>	6	18	4.5	62.2
<i>Frankliniella intonsa</i>	7	15	3.7	65.9
<i>Haplothrips gowdeyi</i>	8	11	2.7	68.6
<i>Frankliniella tenuicornis</i>	9	10	2.4	71.0
<i>Frankliniella schultzei</i>	10	7	1.7	72.7
<i>Melanthrips fuscus</i>	11	6	1.4	74.1
<i>Thrips meridionalis</i>	12	5	1.2	75.3
<i>Thrips flavus</i>	13	5	1.2	76.5
<i>Limothrips cerealium</i>	14	5	1.2	77.7
<i>Thrips atratus</i>	15	4	0.9	78.6
<i>Haplothrips nigricornis</i>	16	4	0.9	79.5
<i>Acolothrips collaris</i>	17	3	0.7	79.3
<i>Thrips simplex</i>	18	3	0.7	80.0
<i>Thrips nigropilosus</i>	19	2	0.5	80.5
<i>Neohydatothrips samayunkur</i>	20	2	0.5	81.0
<i>Limothrips denticornis</i>	21	2	0.5	81.5
<i>Acolothrips deserticola</i>	22	2	0.5	82.0
<i>Thrips australis</i>	23	2	0.5	82.5
<i>Dendrothrips ornatus</i>	24	2	0.5	83.0

APHIS port identifiers. Ports with air flights from Europe and Africa, such as JFKIA (John F. Kennedy International Airport), O'Hare, Atlanta, Houston, Los Angeles, and Seattle, have identifiers with authority to make identifications of some commonly intercepted species without verification from the SEL specialist, and these are not included in this paper. Also, since 1996, routine identifications made by the APHIS/PPQ thrips specialist (Susan Broda) are also excluded. The problem with inclusion of data from APHIS/PPQ is that these data only include information on species that are not already established in the U.S. Thus, the numerous identifications of *Frankliniella occidentalis* and *Thrips tabaci* are not included. Since port identifiers need to identify all species taken at U.S. ports, I decided to use the more complete SEL data. If APHIS/PPQ identifications had been included, the numbers in Tables 2 and 3

would have been skewed toward species that do not occur in the U.S., but it would not have changed the composition of the species list.

In a review of historical records kept by APHIS/PPQ from 1923 to 1984, I noted two trends. (1) Early records are scant. At this time very few records existed of commercial shipments of flowers. Most interceptions were from passenger baggage. These records always were of species found in the top 10 in Table 2, with the exception of *Frankliniella occidentalis* Pergande. This is a U.S. species that has been transported in commerce to other parts of the world in the late 20th century and has become established in Europe and Africa (as well as other parts of the world). It is now one of the most commonly intercepted species (see Tables 2–3). (2) Because of changes in commercial trade, some species that previously were not (or

only rarely) intercepted are now more frequently encountered. For example, *Thrips palmi* Karny, a tropical Asian species, became established in Africa and the Western Hemisphere, and more recently has become established in the U.S. (in Florida and Hawaii). After evaluating species interceptions enumerated in the two databases, I determined that at least 25 species should be added to the list of most commonly intercepted thrips, most of them in the genera *Thrips* and *Haplothrips*. One species becoming increasingly common in interceptions is *Neohydatothrips samaynkur* (Kudo), which was established recently in Kenya. Two other recently established species—*Pezothrips kellyanus* (Bagnall) in the Mediterranean region and *Echinothrips americanus* Morgan in greenhouses—are dispersing and may become commonly intercepted in the near future.

Morphological terminology follows Mound et al. (1976) and Nakahara (1994). Morphological features most often used in the keys include the following (Figs. 1–4): *Anteroangular setae* (Fig. 4): one pair of elongated setae situated on anterolateral corners of pronotum.

Anteromarginal setae: one pair of elongated setae situated submedially on anterior margin of pronotum.

Basantry: paired praepectal plates on prothoracic sternum of species of Phlaeothripidae.

Crespeda (Figs. 19–20): usually overlapping, scalloped scales or transverse plate on posterior margins of abdominal tergites.

Ctenidia (Figs. 54, 56): comblike row of short microtrichia on distal margins of a lateral stria on tergite VIII either anterior or posterior of spiracles, also present (and usually somewhat less conspicuous) or absent on tergites IV–VII.

Fringe cilia (Figs. 1–3): elongated gracile hairlike setae arranged uniformly around costal, apical, and posterior margins of fore- and often hindwings.

Metafurca (= metasternal furca = meta-

thoracic furca) (see Figs. 15–16): forked endosternal process formed from the inflection of the sternum, and with or without a median anteriorly directed process.

Microtrichia: usually well defined short hairlike structure on body, antennae, and wings; those on posterior margin of tergite VIII being particularly useful in species (and sometimes generic) identification.

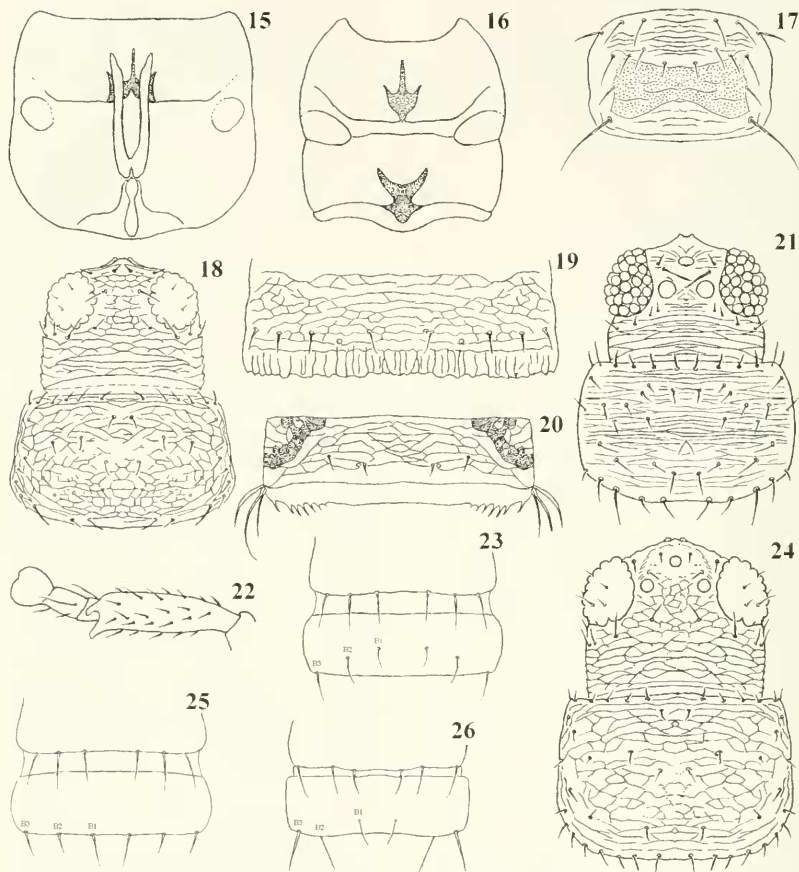
Ocellar setae I, II, III (Fig. 4): pairs of elongated setae situated near ocellar triangle as follows: I, located anterior to fore ocellus; II, located anterolaterad of fore ocellus, and III (or interocellar setae), located usually in triangle formed by ocelli, occasionally laterad of fore ocellus or between hind ocelli.

Posteroocular setae (Fig. 4): 4–6 pairs of setae located on head in a curved row behind compound eyes or occasionally submedially in posterior part of head.

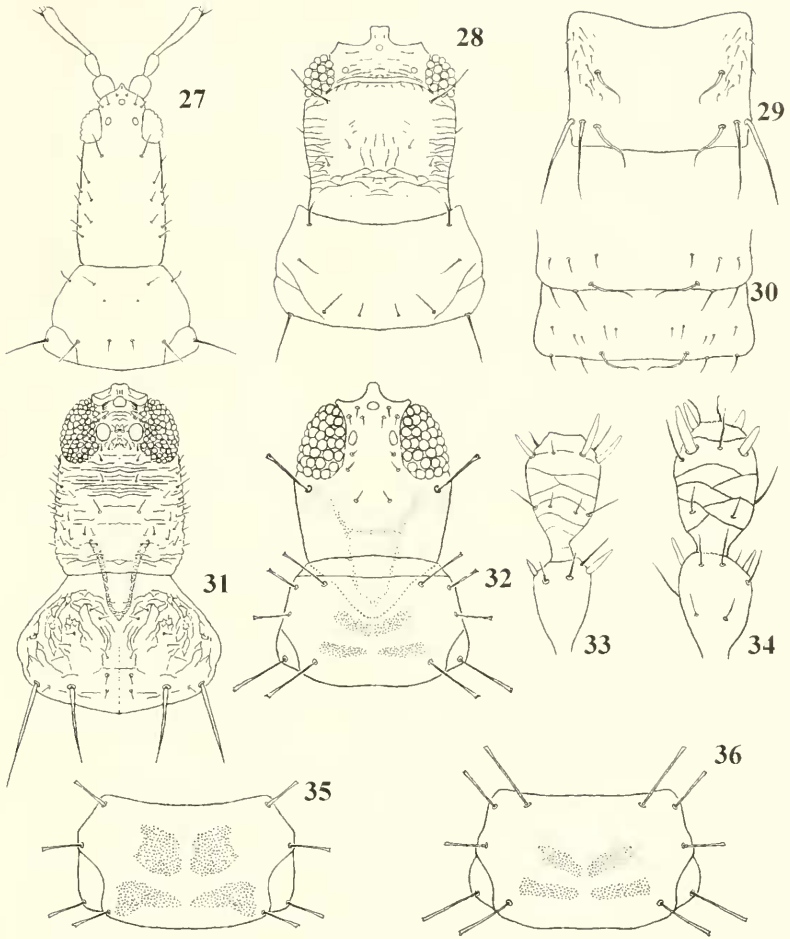
Posteroangular setae (Fig. 4): 1–2 pairs of elongated setae located on or near posterolateral corners of pronotum.

Postermarginal setae (Fig. 4): setae located on posterior margin of pronotum, usually between posteroangular setae. When setae on posteroangles are not developed, they are also defined as postermarginal setae.

Specimens used in scanning electron micrographs (SEMs) were obtained from recent incoming material for urgent identifications. Some of the specimens were cleared and slide mounted in Hoyer's for preliminary identifications, then removed from the slides, placed in 80% ethanol for later preparation for SEMs. Specimens to be prepared for SEMs were transferred overnight into 100% ethanol. They were then critical point dried using a Samway critical point dryer. Dried specimens were glued to paper points attached to SEM stubs and photomicrographed in a scanning electron microscope. Images were digitally captured and transferred to Adobe Photoshop



Figs. 15-26. Morphological features of Thysanoptera, continued. 15, *Dendrothrips ornatus*, metafurca (lyre-shaped). 16, *Linothrips cerealium*, metafurca (U-shaped). 17, *Neohydatothrips* sp., pronotum, dorsal aspect. 18, *Apterothrips secticornis*, pronotum, showing wider than long. 19, *Apterothrips secticornis*, abdominal tergites, showing crespida. 20, *Chaetanaphothrips* tergite VIII, showing glandular area, posteromarginal craspedia, posteromarginal microtrichia, and posterolateral margins. 21, *Dichromothrips corbetti*, head and pronotum, showing 2 pairs of ocellar setae. 22, *Odontothrips karnyi*, foretibia (showing 1 or 2 clawlike processes). 23, *Ceratothripoides brunneus*, sternite VIII. 24, *Anaphothrips obscurus*, head and pronotum, showing 3 pairs of ocellar setae. 25, *Ceratothrips ericae*, sternite VII. 26, *Megalurothrips sjöstedti*, sternite VII.



Figs. 27-36. Morphological features of Thysanoptera, continued. 27, *Elaphrothrips* sp., head and thorax. 28, *Bolothrips* sp., head and pronotum. 29, *Elaphrothrips* sp., showing 2 pairs of wing-retaining setae on tergites. 30, *Bolothrips* sp., showing 1 pair of setae. 31, *Gynaikothrips* sp., showing absence of maxillary bridge. 32, *Haplothrips* sp., showing presence of maxillary bridge. 33, *Karnyothrips* sp., antennal segment IV. 34, *Haplothrips* sp., antennal segment IV. 35, *Karnyothrips* sp., basantra. 36, *Haplothrips* sp., basantra.

5.0" for MacIntosh, where they were edited for publication quality.

Line drawings of specimens were rendered from images observed through a camera lucida attached to a Zeiss Axioskop 2[®] microscope, using both transmitted light and phase contrast modes.

RESULTS

The 1983–93 database was evaluated to determine the range of species being intercepted from Africa, the Mediterranean Region, and Europe over a ten-year period (Table 1). A total of 2,437 interceptions included 51 genera and 129 identified species distributed among three of the families of thrips: Aeolothripidae, Thripidae, and Phlaeothripidae. In addition, 206 specimens were identified only to genus. Species listed

in Table 1 and occurring in the U.S. are also indicated.

The second database (1994–1999) was used to evaluate recent trends in the transport of thrips in commerce from Africa and Europe (Table 2). This database was used to evaluate the most common thrips intercepted in agricultural and horticultural shipments since 1994. In this sample, 497 interceptions were represented by 43 identified species in 18 genera distributed among Aeolothripidae, Thripidae, and Phlaeothripidae. An additional 67 specimens were identified to genus only. From among the 43 species intercepted between 1994 and 1999, 23 represented nearly 85% of the total number of interceptions (Table 3) and comprised 9 genera. From the list of thrips in Table 1, an illustrated key to nearly all of the represented genera is herein provided.

KEY TO PERTINENT FAMILIES OF THYSANOPTERA

(Merothripidae and Heterothripidae are omitted because they lack representation in the database sample.)

1. Forewing with veins, surface with microtrichia; terminal abdominal segment normally not tubular; ovipositor present 2
- Forewing without veins (Fig. 40), surface without microtrichia; terminal abdominal segment tubular (Fig. 41); ovipositor absent Phlaeothripidae
2. Antenna 9-segmented; segments III and IV with sensoria on surface of segment, either elongate and longitudinally oriented along axis of segment or transversely or diagonally oriented, nearly encircling segment near distal apex; forewing relatively broad with rounded apex and several crossveins Aeolothripidae
- Antenna 6- to 9-segmented, segments III–IV with sense cones conical, setiform, or forked; forewing narrow with conical apex and one crossvein Thripidae

KEY TO GENERA

Phlaeothripidae

1. Maxillary stylets broad, band-like, more than 5 μm broad (Idolothripinae, a subfamily of no quarantine importance but sometimes encountered) 2
- Maxillary stylets narrow, less than 2–3 μm broad (Phlaeothripinae) 3
2. Abdominal tergites with at least two pairs of wing-retaining setae (Fig. 29); head elongated, strongly produced forward of eyes (Fig. 27); ocellar setae long *Elaphrothrips*
- Abdominal tergites with only one pair of wing-retaining setae (Fig. 30); head not produced forward of eyes (Fig. 28); ocellar setae short or absent *Bolothrips*
3. Abdominal tergites with one pair of wing-retaining setae in macropterous forms; forewings cross-banded, without accessory cilia; abdominal pelta divided into 3 parts; pronotum without epimeral sutures *Aleurodothrips*
- Abdominal tergites with two pairs of wing-retaining setae in macropterous forms; forewings not banded, with or without shaded areas, with or without accessory cilia; abdominal pelta undivided, consisting of a single plate; pronotum with epimeral sutures (Fig. 32) 4
4. Maxillary stylets with a bridge (Fig. 32); basantra present; forewing medially constricted 5
- Maxillary stylets without a bridge (Fig. 31); basantra absent; forewings parallel-sided 6

5. Antennal segment IV usually with 2-3 (occasionally 4) sense cones (Fig. 33); foretarsus usually with an inner apical curved tooth; abdominal tube with terminal setae 1.5-2.0× length of tube *Karnyothrips*
 - Antennal segment IV with 4 sense cones (Fig. 34); foretarsus with or without a tooth on inner margin behind apex; abdominal tube with terminal setae shorter than or only slightly longer than length of tube *Haplothrips*
6. Maxillary stylets wide apart (Fig. 31); pronotum strongly sculptured, consisting of a swirled pattern; metanotum reticulated *Gynaikothrips*
 - Maxillary stylets nearly touching; pronotum weakly sculptured; metanotum without strong sculpture *Hoplothrips*

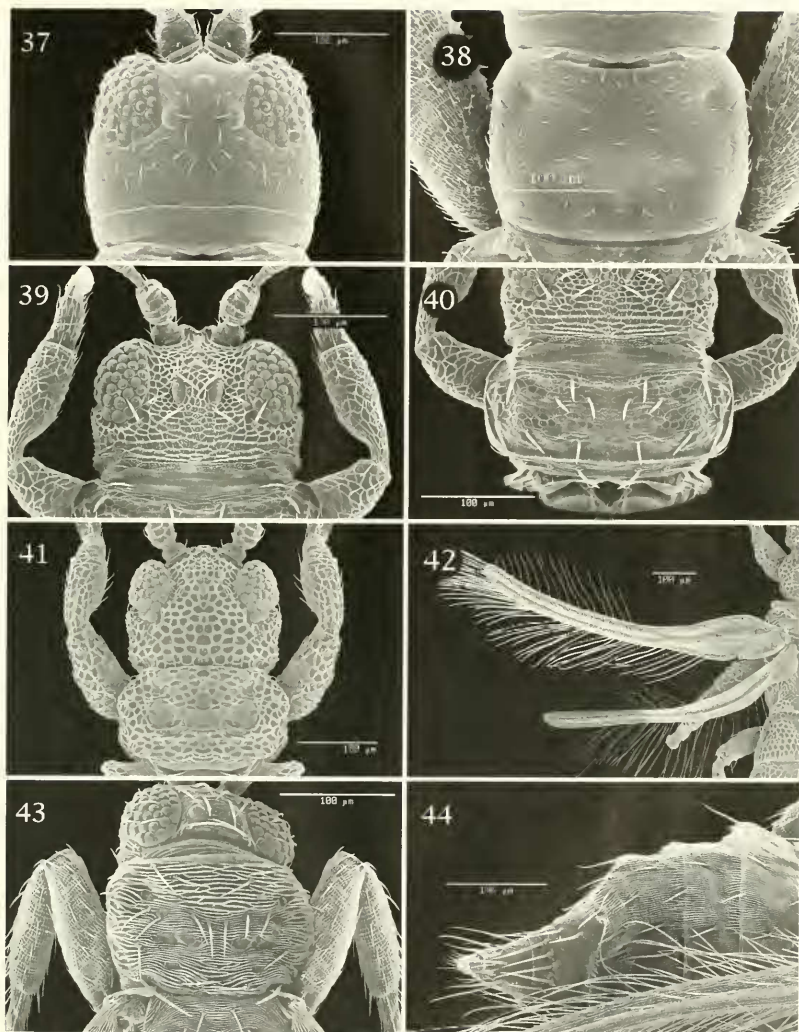
Aeolothripidae

1. Antennal segments long and narrow, III 10-15 times longer than wide; abdomen constricted at base, more or less vespiform *Franklinothrips*
 - Antennal segments only moderately longer than wide, III only 3-6 times longer than wide; abdomen not constricted at base 2
2. Antennal segment III with sensoria elongated and longitudinally oriented (Fig. 8); pronotum with numerous small setae evenly distributed, elongated marginal setae absent (Fig. 5) *Aeolothrips*
 - Segment III with sensoria transverse and diagonally oriented (Fig. 9); pronotum with elongated setae on margins, longest on both anterolateral and posterolateral corners (Fig. 6) *Melanthrips*

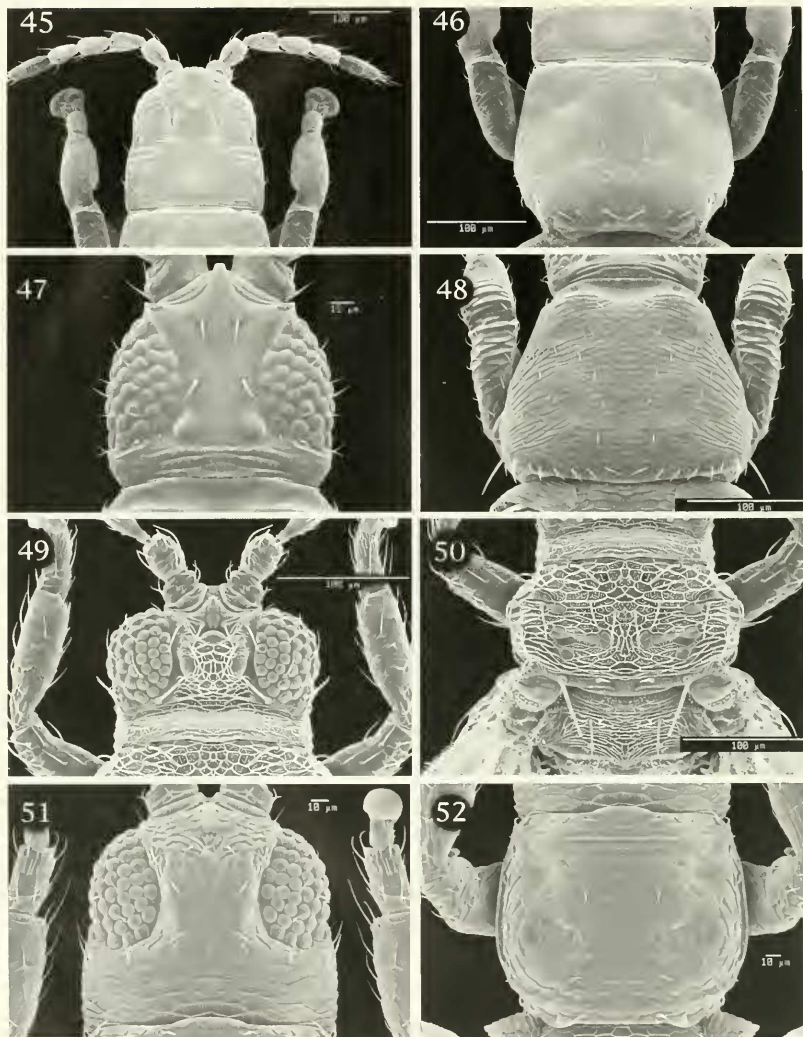
Thripidae

1. Terminal antennal segment greatly elongated (Fig. 10); head, pronotum, and legs usually with well-developed striated or reticulated sculpturation (Fig. 7) (Panchaethothripinae) 2
 - Terminal antennal segment not greatly elongated (Fig. 11); head, pronotum, and legs usually not strongly sculptured (Fig. 12) (Thripinae) 7
2. Anterior margin of forewing interrupted by 2-5 swellings or callosities, without fringe cilia *Retithrips*
 - Anterior margin of forewing entire, not interrupted by swellings or callosities; fringe cilia present or absent 3
3. Antenna 7-segmented; forewing surface finely reticulated, with dark bands and patches *Parthenothrips*
 - Antenna 8-segmented; forewing surface not reticulated, with or without color patterns 4
4. Antennal segments III and IV with forked sense cones; forewing with long setae and cilia along entire anterior margin; veinial setae long; wavy cilia on posterior margin 5
 - Antennal segments III and IV with simple sense cones; forewing without costal setae; veinial setae short, with or without small cilia along distal half of anterior margin; cilia on posterior margin straight 6
5. Tarsi 2-segmented (Fig. 39); pronotum reticulate (Fig. 40); abdominal tergite X deeply medially split *Hercinothrips*
 - Tarsi 1-segmented; pronotum transversely striate; abdominal tergite X entire, without medial split *Selenothrips*
6. Head without a prominent dorsal constriction or ridge behind eyes (Fig. 41); surface of head and pronotum sculptured with well developed regular polygonal reticules (Figs. 12, 41); anterior margin of forewing with fringe cilia on distal half (Fig. 42) *Heliothrips*
 - Head with a prominent dorsal ridge behind eyes; surface of head and pronotum with irregular sculpturation (Fig. 13); anterior margin of forewing lacking fringe cilia *Rhipiphorothrips*
7. Metafurca lyre-shaped, greatly enlarged (Fig. 15); forewing with anterior margin acutely curved to meet straight posterior margin; median tergal setae closer to each other than to lateral setae 8
 - Metafurca U-shaped (Fig. 16); forewing with apex conical or pointed; median tergal setae usually widely separated from each other 9
8. Antenna 8- or 9-segmented; lateral surface of abdominal tergites irregularly reticulated; apex of antennae blunt; anterior row of cilia on forewing arising submarginally *Dendrothrips*
 - Antenna 7-segmented; lateral surface of abdominal tergites smooth; apex of antenna pointed; cilia on anterior margin of forewing arising at margin *Leucothrips*
9. Antenna 6-segmented 10
 - Antenna 7 or 8-segmented 11
10. Macropterous; median tergal setae widely separated by a distance \geq length of seta *Drepanothrips*
 - Apterous; median tergal setae narrowly separated by a distance $<$ length of seta *Aptinothrips* (in part)
11. Lateral surfaces of abdominal tergites with many microtrichia (Fig. 44) 12
 - Lateral surfaces of abdominal tergites bare or with only a few scattered rows of minute microtrichia 15

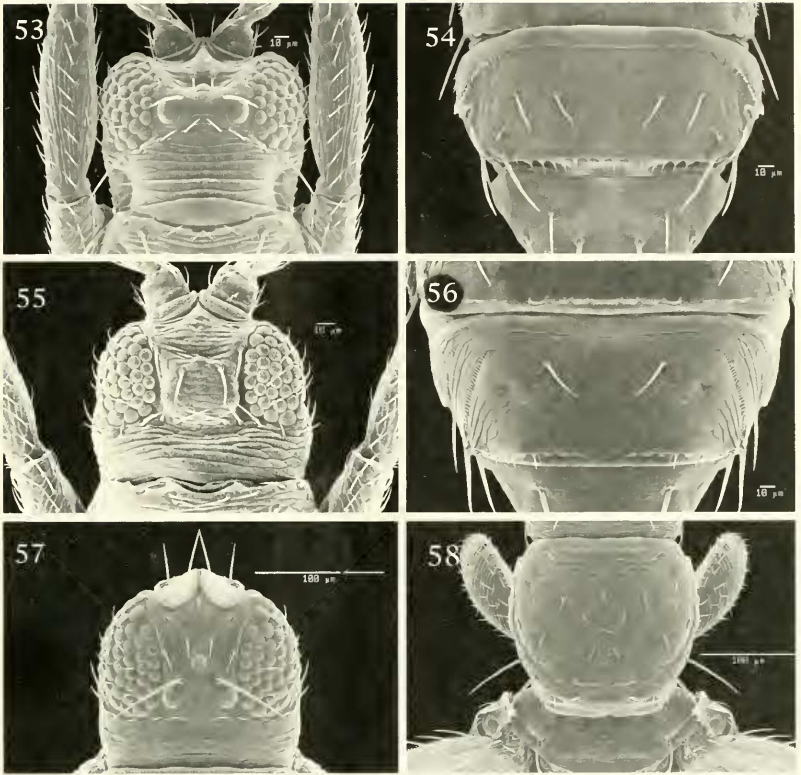
12. Microtrichia on lateral surface of abdominal tergites spine-like, each arising at apex of broad triangulate or dentiform base *Dendrothripoides*
 - Microtrichia on lateral surface of abdominal tergites fine, hairlike, lacking expanded bases (Fig. 44) 14
13. Antennal segments III and IV with simple sense cones; surface of head and pronotum distinctly reticulated (Figs. 49-50) *Echinothrips*
 - Antennal segments III and IV with forked sense cones; surface of head and pronotum striated or variously reticulated 15
14. Forewing with complete row of setae on forevein; abdominal sternite VII with 3 pairs of setae anterior of hind margin; antennal segment VI with base of sense cone elongate, at least $0.3\times$ length of segment; posterior half of pronotum usually with a median, broad blotch outlined by apodeme (Fig. 17); with sculpturation usually differing from anterior half of pronotum (Fig. 43) *Neohydathrips*
 - Forewing with an intermittent row of setae on forevein; abdominal sternite VII with 2 pairs of setae anterior of hind margin; antennal segment VI with base of sense cone circular in cross-section, $< 0.3\times$ length of segment; posterior half of pronotum lacking such an apodeme *Scirtothrips*
15. Brachypterous or apterous species 16
 - Macropterous species 19
16. Pronotum without posteroangular setae (Fig. 18); antennal segments III and IV with simple sense cones 17
 - Pronotum with 1 or 2 pairs of posteroangular setae; antennal segments III and IV with either simple or forked sense cones 18
17. Abdominal tergites and sternites with posteromarginal crespida (Fig. 19); head wider than long (Fig. 18) *Apterothrips*
 - Abdominal tergites and sternites without crespida; head longer than wide *Aptinothrips* (in part)
18. Pronotum trapezoidal, distinctly narrowing anteriorly (Fig. 48); antennal segment II usually angulated anterolaterally; antennal segment III with simple sense cones; tergite VIII lacking ctenidia (Figs. 39-40) *Chirothrips* (in part)
 - Pronotum rectangular or subquadrate; antennal segment II not angulate anterolaterally; antennal segment III with forked sense cones; tergite VIII with ctenidia (Fig. 54) *Frankliniella* spp. (in part)
19. Pronotum trapezoidal, distinctly narrowing anteriorly (Fig. 48); antennal segment II usually angulated anterolaterally *Chirothrips* (in part)
 - Pronotum rectangular or subquadrate; antennal segment II usually not distinctly angulate anterolaterally 20
20. Abdominal tergite X with a pair of sharp stout spines; head produced anterior of eyes (Fig. 45); pronotum with 1 pair of posteroangular setae (Fig. 46) *Limothrips*
 - Tergite X without sharp stout spines; other characters variable 21
21. Abdominal tergite VIII (and often V, VI, and VII) with a pair of well-developed ctenidia (Figs. 54, 56) 22
 - Abdominal tergite VIII without ctenidia but sometimes with irregular microtrichia 24
22. Ctenidia on tergite VIII situated anterolaterad of spiracle (Fig. 54); head with 3 pairs of ocellar setae (Figs. 4, 53); pronotum with 2 pairs of long posteroangular setae, 1 pair of long anteroangular setae, 1 pair of long anteromarginal setae (Fig. 54); forewing with setae on both forevein and hindvein in complete rows *Frankliniella* (in part)
 - Ctenidia on tergite VIII situated posteromedial of spiracle (Fig. 56); head with 2 pairs of ocellar setae (Fig. 55); pronotum with 2 pairs of posteroangular setae, but no long anteroangular setae or anteromarginal setae 23
23. Pronotum with 3-4 pairs of posteromarginal setae and 2 pairs of long posteroangular setae; posteromarginal crespida absent on abdominal tergites II-VII (Fig. 56) *Thrips*
 - Pronotum with 5-6 pairs of posteromarginal setae and 2 pairs of short posteroangular setae (Fig. 36); dentate posteromarginal crespida present on abdominal tergites II-VII *Microcephalothrips*
24. Abdominal segment VIII with glandular area surrounding spiracle and extending medioanteriorly to anterior margin of tergite VIII (Fig. 20); posterolateral margins of tergites II-VII posteriorly with crespida *Chaetanaphothrips*
 - Abdominal segment VIII lacking glandular area; posterolateral margins of tergites II-VII lacking crespida 25
25. Pronotum with 6 pairs of elongate setae *Scolothrips*
 - Pronotum with fewer elongate setae 26
26. Pronotum without posteroangular setae (Fig. 24) 27
 - Pronotum with 1-2 pairs of posteroangular setae (Figs. 21, 58) 29



Figs. 37–44. Scanning electron micrographs of thrips. 37–38, *Aeolothrips collaris*, dorsal aspects. 37, Head. 38, Pronotum. 39–40, *Hercnothrips brunneus*, dorsal aspects. 39, Head. 38, Pronotum. 41–42, *Heliiothrips haemorrhoidalis*, dorsal aspects. 41, Head. 42, Left wings. 43–44, *Neohydatothrips samayunkur*, dorsal aspects. 43, Head and pronotum. 44, Left side of abdomen.



Figs. 45-52. Scanning electron micrographs of thrips. 45-46, *Limothrips cerealium*, dorsal aspects. 45, Head. 46, Pronotum. 47-48, *Chirothrips manicatus*, dorsal aspects. 47, Head. 48, Pronotum. 49-50, *Echinothrips americanus*, dorsal aspects. 49, Head. 50, Pronotum. 51-52, *Anaphothrips obscurus*, dorsal aspects. 51, Head. 52, Pronotum.



Figs. 53–58. Scanning electron micrographs of thrips. 53, *Frankliniella occidentalis*, dorsal aspect: head. 54, *Frankliniella tenuicornis*, dorsal aspect: tergite VIII, showing position of ctenidia. 55–56, *Thrips major*, dorsal aspects. 55, Head. 56, Tergite VIII, showing position of ctenidia. 57–58, *Megalurothrips sjöstedti*, dorsal aspects. 57, Head. 58, Pronotum.

27. Posterior margin of tergite VIII with a complete, well-developed comb	<i>Anaphothrips</i>
– Posterior margin of tergite VIII without a comb of setae	28
28. Antenna 8-segmented; postocular setae in a single row; median setae on abdominal tergites VI–VIII long, on tergite VIII more than half length of tergite	<i>Tameothrips</i>
– Antenna 9-segmented; postocular setae loosely arranged in 2 rows; median setae on abdominal tergites VI–VIII short, less than half length of tergite	<i>Palmiothrips</i>
29. Pronotum with 1 pair of posteroangular setae	30
– Pronotum with 2 pair of posteroangular setae	32
30. Posterior margin of tergite VIII without a comb; head with 3 pairs of ocellar setae; abdominal sternites IV–VI usually with a few discal setae	<i>Oxythrips</i>
– Posterior margin of tergite VIII with a complete comb; head with 2–3 pairs of ocellar setae; abdominal setae without discal setae	31
31. Head with 2 pairs of ocellar setae; with metasternal spinula; abdominal tergite X without median split; antennal segments III and IV narrowed distally, with rather large forked sense cones	<i>Dichromothrips</i>

- Head without ocellar setae; without metasternal spinula; abdominal tergite X with median split; antennal segments III and IV weakly narrowed distally, with short forked sense cones *Glaucothrips*
- 32. Antennal segment VI sense cone stout, with elongate base; forewing with complete row of veinal setae on forevein or 2 distal setae separated from row; foretibia with 1–2 apical spinelike or clawlike processes (Fig. 22) *Odontothrips*
- Antennal segment VI sense cone elongate, with short base; veinal setae variable; foretibia without an apical spine or clawlike process 33
- 33. Metasternal furca with a spinule; forewing with 2 distal setae on foreveins; 2 pairs of pronotal posteromarginal setae *Mycterothrips*
- Metasternal furca without a spinule; other characters variable 34
- 34. Head with 2 pairs of ocellar setae *Taeniothrips*
- Head with 3 pairs of ocellar setae 35
- 35. Forewing scale with 6 veinal setae; discal seta absent; tergite VIII with complete posteromarginal comb of microtrichia; B1 and B2 setae on sternite VII anterior of posterior margin, B3 on posterior margin (Fig. 23) *Ceratothripoides*
- Forewing scale with 4 or 5 veinal setae; discal seta present; tergite VIII with posteromarginal comb of microtrichia medially interrupted or absent; B2 and B3 setae on sternite VII on posterior margin (Figs. 25–26); B1 either on or anterior of posterior margin 36
- 36. Forewing scale with 4 veinal setae; anterior vein of forewing with 2–3 setae in distal ¼ of vein separated from nearly uninterrupted row *Megalurothrips* (Figs. 26, 57–58)
- Forewing scale with 5 veinal setae; anterior vein of forewing with 2–4 intermittent setae in distal ½ 37
- 37. All facets of compound eyes unpigmented; B1, B2, and B3 setae on sternite VII on posterior margin (Fig. 25) *Ceratothrips*
- Compound eye with 5 pigmented facets; B1 setae on sternite VII arising anterior of posterior margin, B2 and B3 on posterior margin (cf Fig. 26) *Tenothrips*

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